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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

16JUN03 E815321-1 D00346
P01/7700 0.00-0313883.1

1. Your reference — AT-G33037

2. Patent application number *(The Patent Office will fill in this part)* — 0313883.1

3. Full name, address and postcode of the or of each applicant *(underline all surnames)* — Hunting Industrial Coatings Ltd
Derby Road
Widnes
Cheshire
WA8 9ND

Patents ADP number *(if you know it)* — 6880777001

If the applicant is a corporate body, give the country/state of its incorporation — England

4. Title of the invention — Dispensing Apparatus

5. Name of your agent *(if you have one)* — Bailey Walsh & Co
5 York Place
Leeds
LS1 2SD

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Patents ADP number *(if you know it)* — 224001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number	Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d)) — Yes

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Dispensing Apparatus

This invention relates to fluid dispensing apparatus, and particularly although not necessarily exclusively, to fluid dispensing apparatus for dispensing a fluid lining material onto one or more walls of a conduit, pipe or channel.

Conduits and channels are used in a wide range of industries for transportation of a fluid or solid or storage thereof, such as for example, for use in the transportation of gas, water, sewage and/or the like. Although the following description makes reference to fluid dispensing apparatus for use in dispensing a lining material in generally cylindrical water or gas pipes, it will be appreciated by persons skilled in the art that the present invention has far wider application and can be used in any shaped or dimensioned conduit or channel for use in any industry.

A problem with water pipes is that scale can build up on interior walls thereof, thereby restricting the quantity and flow of water through the pipe. In addition, many water pipes in use today are old and are susceptible to corrosion and leakage. This is particularly problematic with gas or sewage pipes, wherein leakage thereof has both dangerous and environmental implications. In order to overcome this problem, the pipes either have to be replaced regularly or a new smaller pipe inserted in the older pipe. However, this typically requires the digging up of roads or pavements, which is inconvenient and expensive. Alternatively, the pipes can be refurbished by applying a lining material to the interior walls of the pipe to increase the structural properties and strength of the pipe. This lining material can be applied manually by workers entering the conduit and spraying a fluid thereon which cures to form a

substantially rigid liner, or can be applied automatically, typically using remote controlled dispensing apparatus.

An example of a conventional remote controlled dispensing apparatus for dispensing a lining fluid onto interior walls of a conduit is disclosed in EP1174191. The dispensing apparatus in this patent application includes reservoirs for the containment of fluid which are connected to two dispensing outlets, each outlet for dispensing a different fluid component therefrom. Drive means are provided for driving the movement of the apparatus through a conduit and a cup shaped rotary head is provided opposite the two dispensing ourlets onto which the two fluid components are dispensed for mixing. The cup shaped rotary head spins the mixrure out of an open end thereof onto the interior walls of the conduit.

A problem associated with the abovementioned apparatus and other conventional dispensing apparatus is that the thickness of the lining material applied to the conduit walls is often too thin, thereby making the lining brittle and requiring passing of the apparatus through the conduit a number of times in order for the required thickness of lining material to be built up by the application of multiple layers (i.e. "a multiple pass system"). This is both expensive and time consuming. To the best of the applicants knowledge, it is not currently possible to apply a number of layers of lining material on an area of a conduit wall at any one time due to the prolonged period of time it takes for conventional lining fluids to cure. Furthermore, application of a thicker single layer of lining fluid is not possible since the lining material begins to sag and provides an uneven distribution of material on the interior conduit walls.

It is therefore an aim of the present invention to provide dispensing apparatus which overcomes the abovmentioned

problems and which provides an inexpensive and simpler alternative to conventional dispensing apparatus.

According to a first aspect of the present invention there is provided dispensing apparatus for use in dispensing a fluid lining material in a conduit, said dispensing apparatus including a reservoir for the containment of a fluid, dispensing outlet means communicating with said reservoir for dispensing fluid therefrom and directional means for directing the dispensed fluid in a requited direction onto one or more walls of said conduit, and characterised in that at least the directional means are capable of undergoing reciprocal motion relative to a part of the apparatus in use.

The provision of at least the directional means and dispensing outlet means with the means to undergo reciprocal motion, typically relative to a further portion of the apparatus, allows multiple layers of fluid to be applied to the walls of the conduit during any "single pass" of the apparatus through the conduit.

The reciprocal motion and thus the application of multiple layers of fluid on the walls of the conduit typically occurs during linear movement (i.e. single pass) of the dispensing apparatus through the conduit.

Drive means can be provided to drive the linear movement of the apparatus through the conduit.

Preferably the reciprocal motion means includes any or any combination of one or more hydraulic pistons, pneumatic pistons, mechanical components, such as a crank shaft and/or the like.

In a preferred embodiment the reciprocal motion means includes a ball reverser. The advantage of the ball reverser is that there is no requirement for electronic circuitry or control systems, thereby limiting the cost of manufacture of the same and allowing easy maintenance thereof. Furthermore, the ball reverser requires to be driven in one direction only, thereby simplifying the components required.

Preferably the dispensing outlet means and the directional means are capable of undergoing reciprocal motion.

Preferably the directional means includes a rotational head member mounted on the apparatus via connection means, typically in the form of an aperture in which a shaft or arm member is mounted. The shaft or arm member is rotated by drive means provided in the apparatus, thereby resulting in rotation of the rotational head member.

Preferably the rotational head member is rotated at approximately 15,000RPM.

The rotational head member is typically provided at the front of the apparatus in the direction of travel.

Preferably the rotational head is provided with a recessed portion into which the dispensing outlet means dispenses the fluid. Impact of the fluid in the rotating recessed portion, deflects the fluid therefrom and onto the walls of the conduit.

Preferably the interior side walls of the recessed portion taper outwardly (i.e. is inclined with respect to the longitudinal axis of the head), from an end opposite the dispensing outlet means to an outer free edge, thereby aiding the deflection or flow of the

fluid from the recessed portion and onto the walls of the conduit.

Further preferably at least one directional member is provided in said recessed portion. The dispensed fluid impacts with the directional member prior to flowing along the interior side walls and out of said outer free edge of the recessed portion. The directional member has the advantage that it prevents or at least reduces the build up of fluid in the recessed portion in use, directs the flow of fluid along the interior side walls of the head member and aids the even distribution of fluid from the rotational head and onto the conduit walls.

In one embodiment the at least one direction member is in the form of a truncated cone. The cone is typically located on the wall of the recessed portion opposite the dispensing outlet means, thereby ensuring the dispensed fluid impacts initially with the tapered walls of the cone. The base of the truncated cone is typically provided at a point furthest from the dispensing nozzle.

The shaft or arm member which results in rotation of the rotational head can be located through the truncated portion of the cone.

In one embodiment the dispensing outlet means is in the form of a housing provided with a compartment therein, said compartment having at least two inlets and an outlet. The compartment typically acts as a impingement mixing chamber allowing at least two different fluids to be separately delivered to the compartment via the two inlets prior to being mixed and dispensed from said outlet. The ability to mix the fluids in the compartment just prior to dispensing from said outlet is

advantageous, particularly if the fluids, when mixed, have a rapid curing or reaction time.

For example, in a preferred embodiment of the present invention the fluid being dispensed includes an amine and an aromatic isocyanate which, on mixing results in a mixture having a curing time of seconds. Thus, it is essential that the mixing compartment is adjacent the dispensing outlet to prevent curing of the mixture and thus blockage of the outlet.

Preferably the fluid being dispensed from the apparatus has a curing time of less than 10 seconds. Further preferably the fluid has a curing time of approximately 3 seconds.

Preferably the dimensions of the mixing compartment and/or outlet are less than the dimensions of the two inlets, thereby ensuring increased pressure in the compartment relative to the inlet passages to allow rapid flow of mixed fluid therethrough. This prevents or at least reduces curing of the mixed fluid in the compartment.

Control means are typically provided with the dispensing apparatus, either directly thereon or remotely therefrom, for controlling any or any combination of the rotational speed of the directional means, the temperature of the fluid and/or the pressure of fluid delivery in the apparatus.

According to a second aspect of the present invention there is provided directional means for use with fluid dispensing apparatus, said directional means including a recessed portion into which fluid is dispensed in use, connection means for connecting the direction means to the fluid dispensing apparatus and characterised in that at least one directional member is located in the recessed portion for aiding flow of the fluid along

the walls defining the recessed portion and out of an outer edge thereof.

Preferably the direction member is in the form of a truncated cone.

According to a further aspect of the present invention there is provided dispensing outlet means for use with dispensing apparatus, said dispensing outlet means including a housing defining a compartment therein, characterised in that said compartment is provided with at least two inlets and an outlet.

Preferably the dimensions of the two inlets are greater than the dimensions of the compartment, thereby allowing rapid flow of mixed fluid in the compartment. The outlet can be provided of similar or smaller dimensions to the compartment.

According to yet further aspects of the present invention there is provided a method of applying a fluid onto a surface using dispensing apparatus, use of a lining fluid with dispensing apparatus and lining fluid dispensing apparatus.

The advantage of the present invention is that the fluid dispensing apparatus allows a multilayered lining to be applied to the interior walls of conduits in a single pass of the apparatus through the conduit. This allows any required thickness of lining to be produced. The lining fluid rapidly cures on application to the walls of the conduits, thereby protecting the conduit from deterioration/corrosion and increasing the structural properties thereof. The lining fluid applied in accordance with the present invention provides a smooth, even and glossy finish to the interior wall surfaces of the conduit, thereby reducing the build up of scale or other debris/contaminants thereon.

The fluid dispensing apparatus can be used for the refurbishment of existing conduits or channels and/or can be used to provide a lining on new conduits or channels.

An embodiment of the present invention will now be described with reference to the accompanying figures, wherein:

Figure 1 is a cross sectional view of dispensing apparatus according to an embodiment of the present invention;

Figures 2a and 2b illustrate the dispensing apparatus in two positions during reciprocal motion;

Figure 3 is a cross sectional view of directional means according to one embodiment of the present invention;

Figures 4a and 4b illustrate a cross sectional view and an end view respectively of dispensing outlet means in one embodiment; and

Figures 5a-5d illustrate dispensing apparatus according to the present invention in use in conduits.

Referring to the figures, there is illustrated dispensing apparatus 2 for the dispensing of a fluid lining mixture for lining the interior walls of a conduit 4.

The fluid lining mixture for use with the apparatus of the present invention in one example, when cured, provides a lining which is sufficiently strong and resistance to wear and corrosion and which is capable of standing alone (i.e. forms a conduit within a conduit), even after the original outer conduit has eroded away.

The mixture includes an amine and an aromatic isocyanate, together with a filler component which typically has a cleaning function in the apparatus of the present invention, and an optional colouring pigment, which can be used to identify the function of the pipe, such as gas or water pipe. Conventionally, filler components have been used in lining mixtures but only to provide bulk thereto and not to provide a cleaning function as in the present invention.

The fluid lining, when mixed, cures rapidly and typically within approximately 3 seconds, especially formulated to avoid the problem of shrinking associated with conventional lining mixtures. Due to the rapid curing of the mixture, this allows multiple layers of lining material to be applied to the interior walls of a conduit in rapid succession, thereby allowing the thickness of the lining to be built up quickly, typically up to thicknesses of 6-8mm, or possible greater in some cases. However, the rapid curing rate creates the potential problem of curing of the fluid in the apparatus prior to application on the conduit walls. Thus, the present invention has been designed to utilise the advantages provided by the rapid curing liner mixture whilst overcoming conventional problems associated therewith.

In accordance with the present invention, the dispensing apparatus 2, includes dispensing outlet means in the form of a spray nozzle 6 for dispensing fluid pumped from a reservoir (not shown) therefrom, directional means in the form of a rotational head 8 for directing the dispensed fluid onto the conduit walls 4 and drive means (not shown) for driving the movement of apparatus 2 through the conduit.

The rotational head 8 is connected to apparatus 2 via a drive shaft 10. Rotation of drive shaft 10 and thus rotational head 8 is driven by a pneumatic air motor 12.

The two component lining fluid (amine and aromatic isocyanate) are separately pumped into the spray nozzle 6 via inlet channels 14, 16, as shown in figures 4a and 4b. The inlet channels 14, 16 are connected to pipes through which the fluid components are pumped from reservoirs typically located remotely from the applicator part of the dispensing apparatus. The fluids then enter and become mixed in a compartment 18 prior to being dispensed through open end 20 of outlet passage 22.

The diameter of compartment 18 is less than the diameter of inlet channels 14, 16, thereby ensuring rapid flow of the mixture through compartment 18 to prevent curing of the mixture therein.

The open end 20 of spray nozzle 6 oppositely faces rotational head 8, thereby allowing fluid dispensed from open end 20 to impact a surface of head 8 in a recessed portion 24 thereof. The rotational head 8 is generally cup shaped including a closed end 26, side walls 28 and an open end 30. At least the interior surface of side walls 28, which define the recessed portion 24, together with end 26, taper outwardly relative to a longitudinal axis of the head indicated by reference 32.

In accordance with an inventive aspect of the rotational head, a truncated cone 34 is provided substantially centrally of the recessed portion 24, as shown in figure 3. A channel 36 is provided through the truncated cone for location of drive shaft 10 therein. The side walls 38 of truncated cone 34 diverge outwardly in an opposite direction to the interior side walls of head 8 (i.e. towards end 26) and are at an angle of less than 90 degrees to the longitudinal axis 32. The angle of the interior side walls 28 relative to the longitudinal axis is greater than 0 degrees

and less than 90 degrees. For example, the angle can be any of 45, 50, 55, 60, or 65 degrees.

During dispensing, a bead of fluid is directed onto side wall 38 of truncated cone 34, which directs the flow of the fluid in the direction of dispensing/impact, thereby preventing fluid flow back towards the dispensing nozzle which would typically result in a build up of cured material on the head. As such, the fluid flows towards end 26 via side walls 38 and then towards open end 30 via interior side walls 28 as a result of rotation of head 8. When the fluid reaches outermost edge 40 of the head it is spun outwardly onto the walls of the conduit. This process occurs rapidly due at least in part to the rapid rotation of the head, thereby preventing or at least reducing the likelihood of fluid curing on the head.

In accordance with a further aspect of the present invention, in order to allow multiple layers of lining fluid to be applied in rapid succession, reciprocating means are provided to allow the head 8 and dispensing nozzle 6 to undergo reciprocal motion relative to the housing 42 of the apparatus and conduit. This reciprocal motion is typically substantially simultaneous to linear movement of the apparatus along the conduit. Figure 2a illustrates head 8 in an extended position relative to housing and figure 2b illustrates head 8 in a retracted position. Arrow 44 illustrates movement of head 8 in a forwards and backwards direction between said extended and retracted positions. The provision of reciprocal means allows multiple layers of lining material to be provided to reach a required thickness during only a single pass of the apparatus through the conduit.

The reciprocal means drives movement of carriage 46, which includes ceramic linear bearings and which is connected to motor 12 via motor clamp 48. The motor 12 in turn is connected

to the rotational head and dispensing nozzle. Carriage 46 moves backwards and forwards along linear shafts 50 provided between end plates 52 in housing 42.

The reciprocal means includes a ball reverser comprising a ball reverser nut 54 which is driven by motor 56 in a forwards and backwards direction along a ball reversing screw 58 (cross hatch arrangement not shown for purposes of clarity) Motor 56 is typically a reverser driven air motor which drives nut 54, and thus carriage 46 in a single direction only, the arrangement of channels/grooves on screw 58 allowing movement of the nut in a forwards and backwards direction. A clamp 60 is provided for clamping motor 56 in position within housing 42 and a flexible coupling 62 is provided between reverser screw 58 and motor 56.

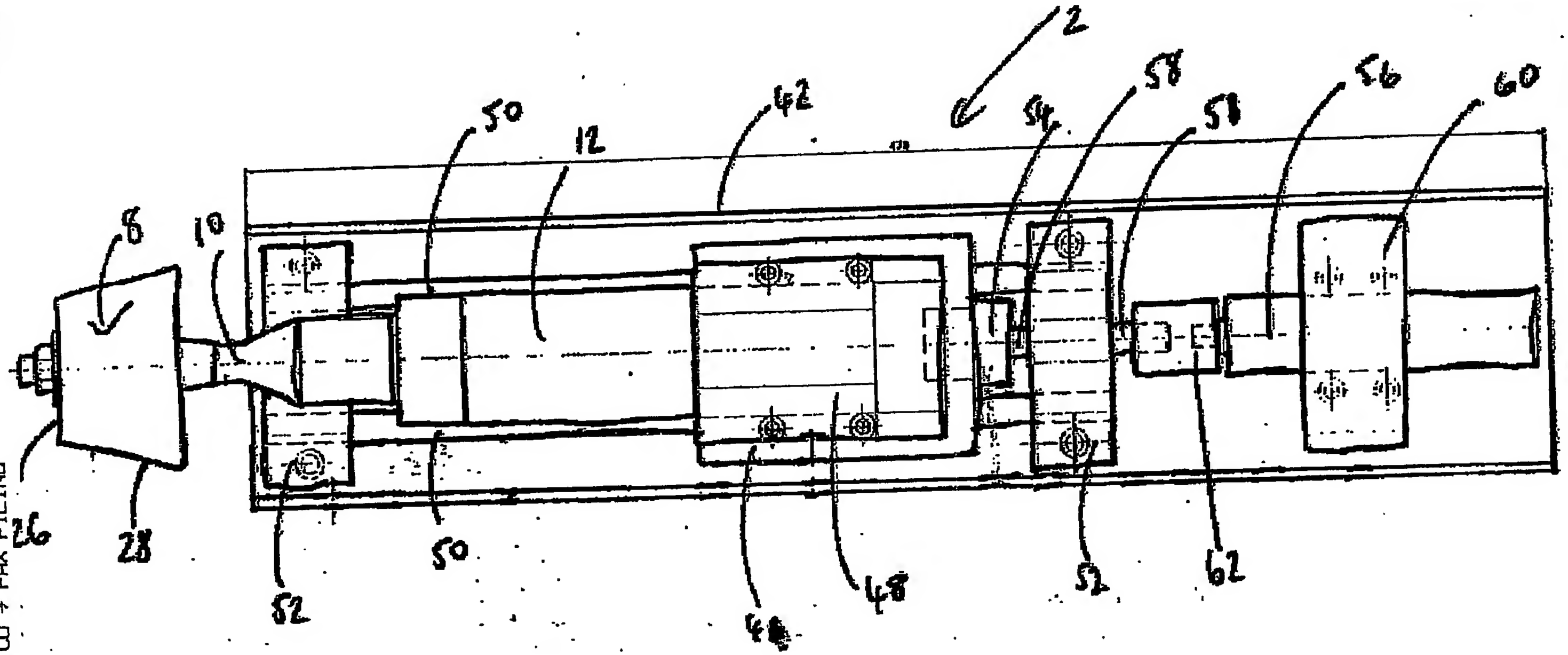
Other components can be provided in the apparatus, such as heating means (i.e. heat exchanger) for heating the lining components to keep them fluid in the apparatus (i.e., up to 75°C), micro-processing means or metering system for controlling the temperature, speed and/or pressure of the fluid in the apparatus, purge means (i.e. nitrogen purge system) for purging the isocyanate component, fluid reservoirs, pumps, filter means, control means for controlling the speed of linear movement of the apparatus through the conduit (i.e. hose or winch speed) and/or any of the abovementioned components.

The reciprocating distance between the extended and retracted positions of head 8 typically depends on the curing time of the lining mixture used, the size of the equipment, the size of the conduit and/or the like. The minimum distance of reciprocation is typically 100mm since sufficient time must pass between repeated motions to allow curing of the lining material previously applied.

The conduit can be any size or shape, such as for example square, rectangular or circular in cross section.

Thus, the present invention provides dispensing apparatus, typically remote controlled, and method of use thereof, which allows any requited thickness of lining to be applied to a surrounding following a single pass. The number of reciprocal motions undertaken by at least part of the apparatus typically depends on the thickness of the lining material required.

APPLICATION TOOL



WATERLINE EQUIPMENT LTD

1	Ø70 SPINNER HEAD	11	S/H MOTOR CLAMP
2	S/H ADAPTOR SHAFT	48	BALL REVERSER NUT
3	END PLATE	52	BALL REVERSING SCREW
4	LINEAR SHAFTS	10	FLEXIBLE COUPLING
5	SPINNER HEAD AIR MOTOR	62	REVERSER DRIVE AIR MOTOR
6	CARRIAGE. C/W CERAMIC LINEAR BEARINGS	60	REVERSER DRIVE MOTOR CLAMP

Figure 1

APPLICATION TOOL

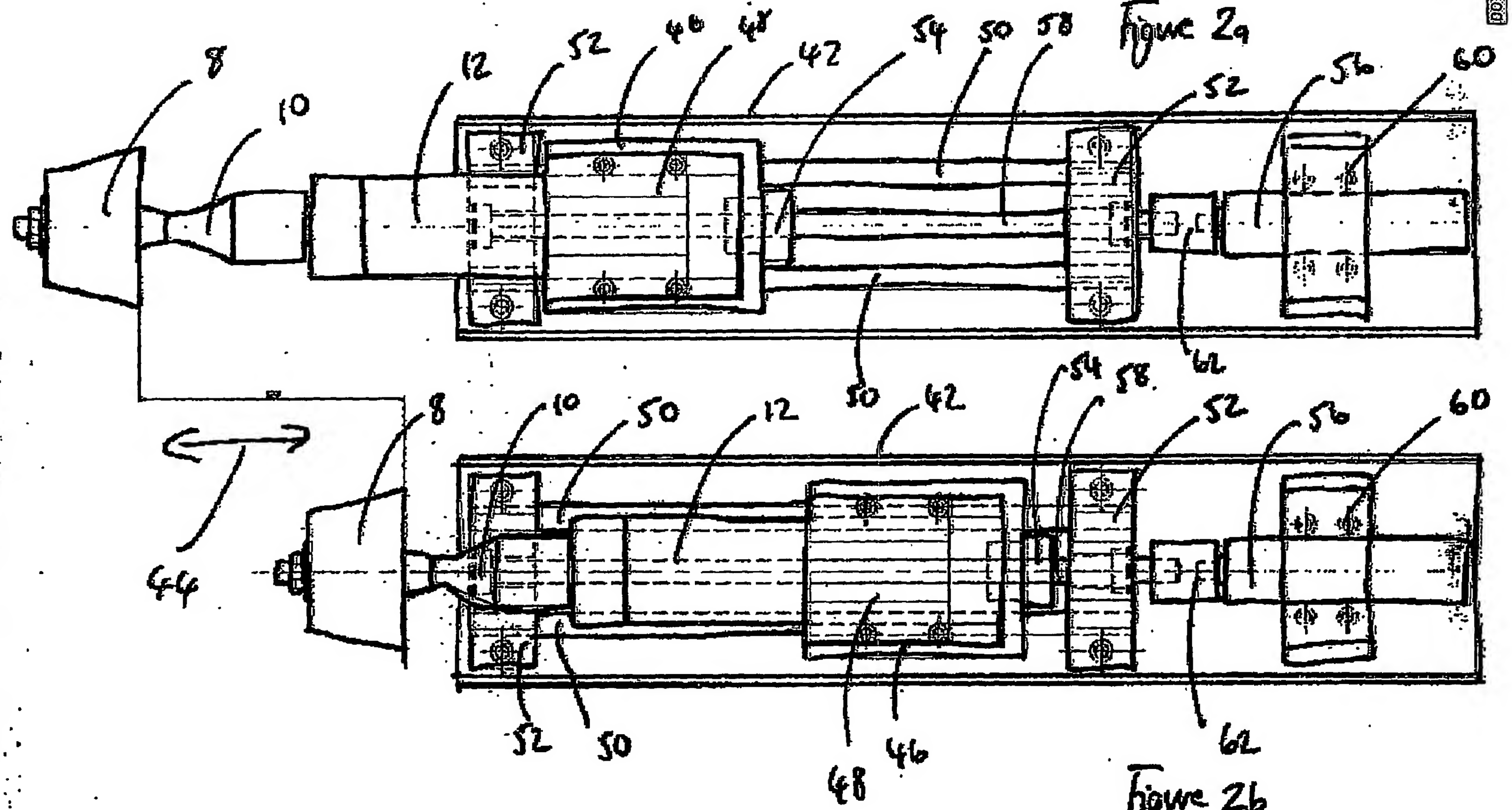


Figure 2a

Figure 2b

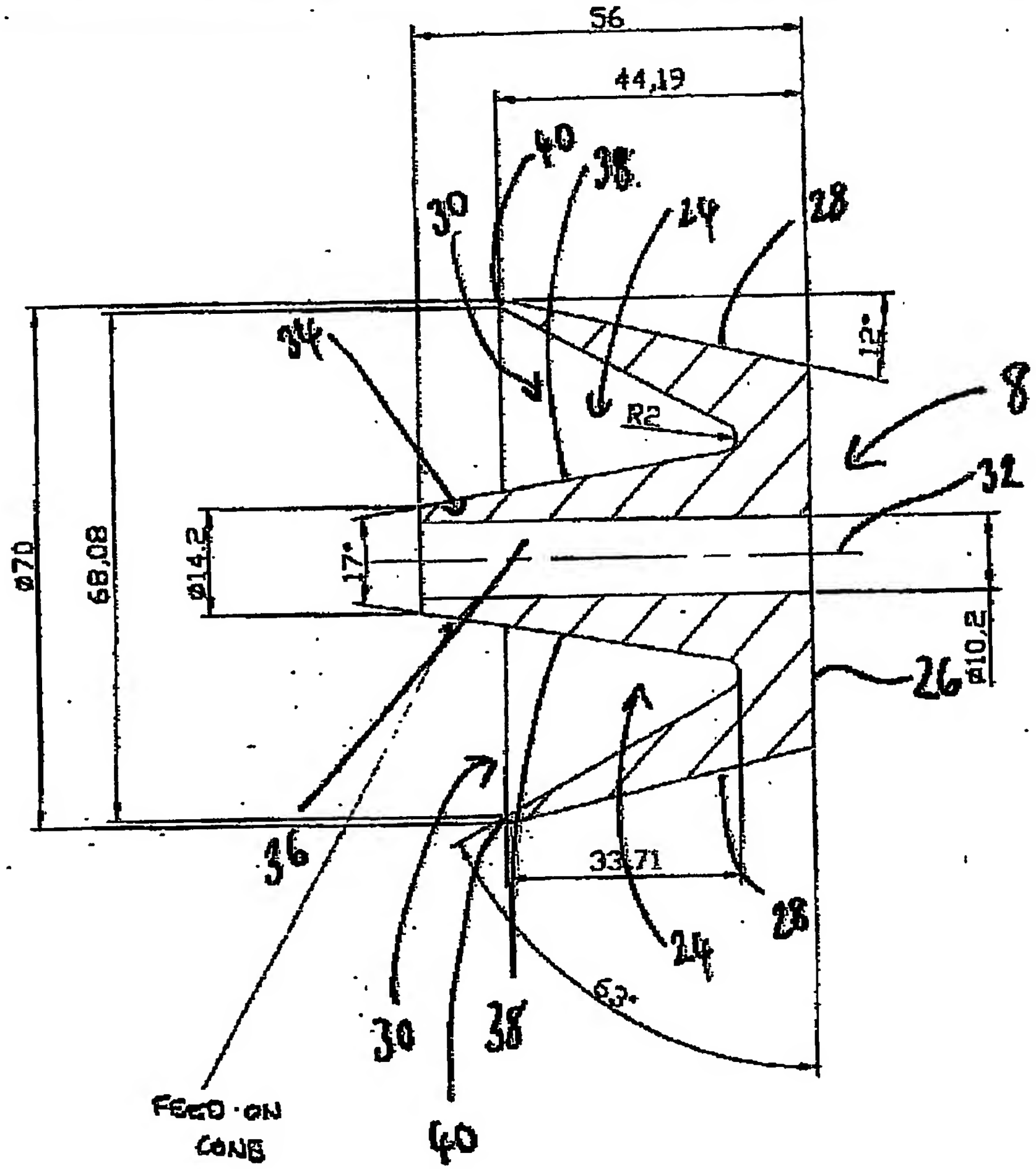


Figure 3

TITLE	ø70mm HEAD (4" PIPES)	
DRG No	A4/1076	
DATE	APRIL 03	
DRAWN BY	DAVE SOUTHWARD	
SCALE		MATERIAL - NYLON (MC901)

WATERLINE EQUIPMENT LTD

IMPINGEMENT MIXING CHAMBER

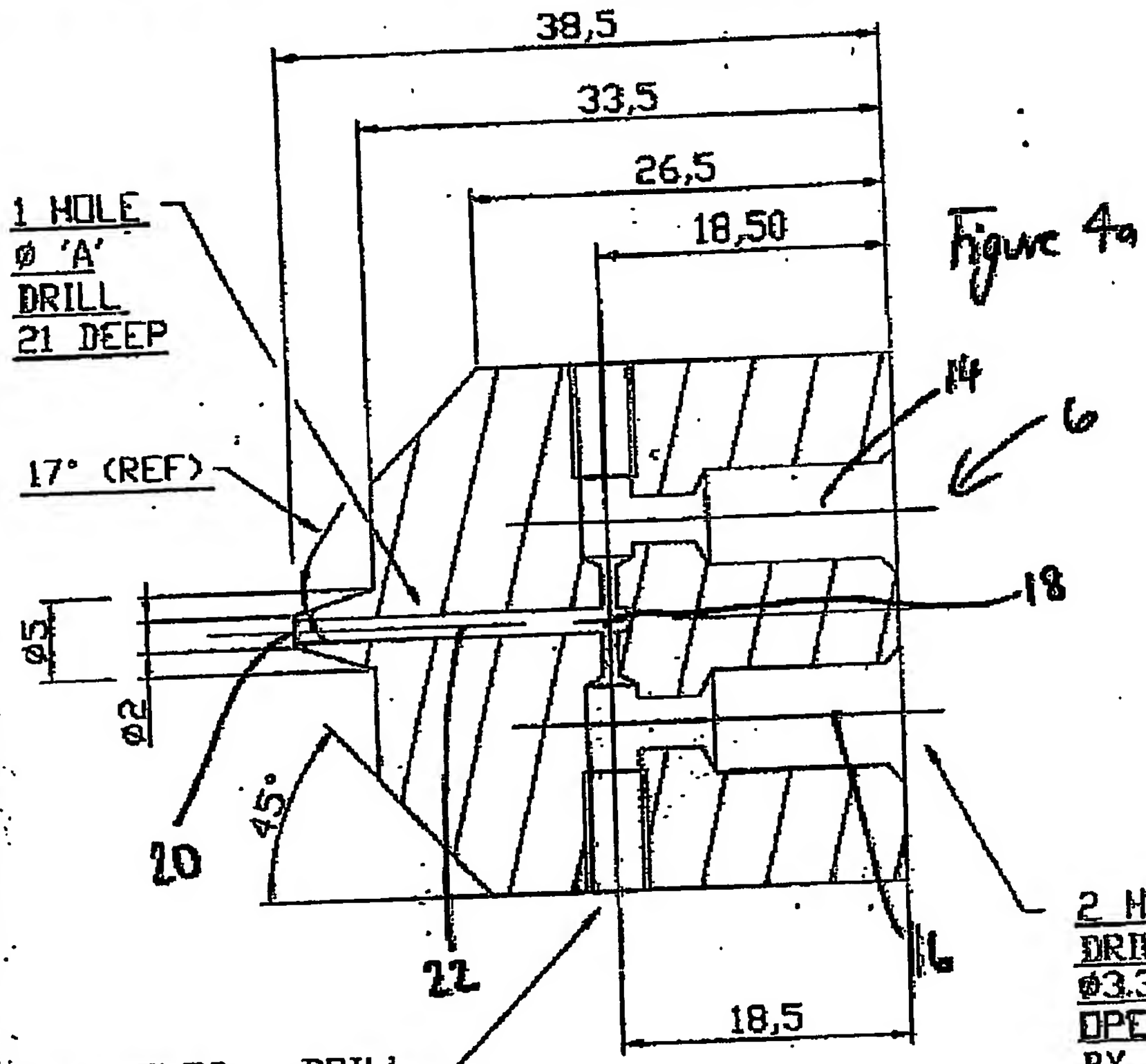


Figure 4a

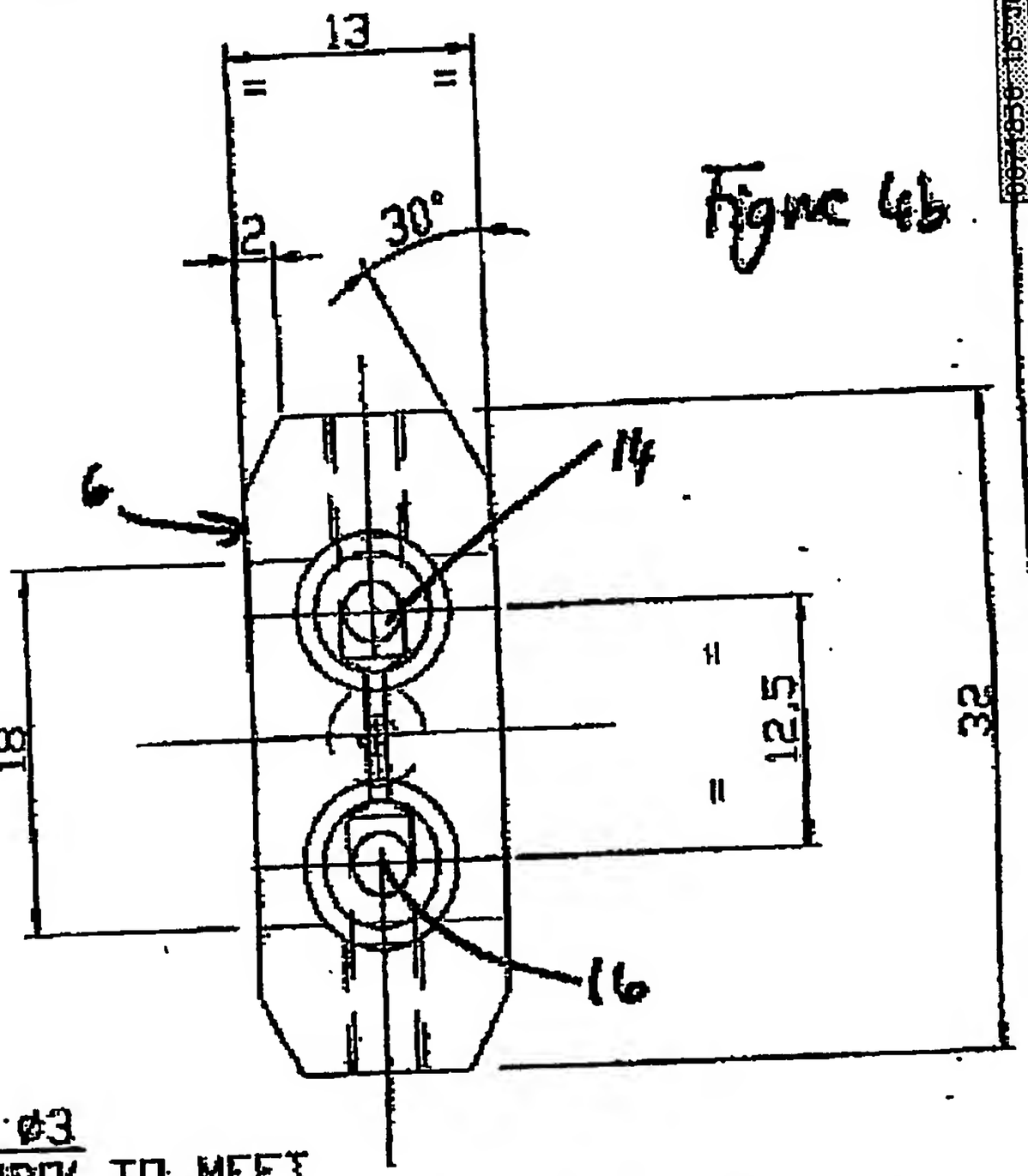


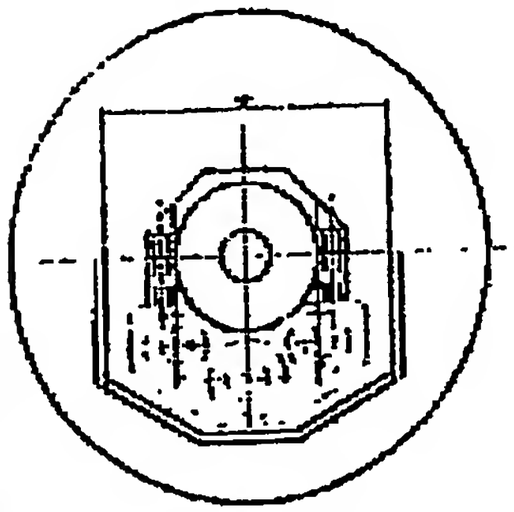
Figure 4b

DRAWING	DIA 'A'
4/1175/1-01	ø1.0
4/1175/1-02	ø1.5

TITLE	SPRAY NOZZLE
DRG No	4/1175/1-[illegible]
DATE	[illegible]
DRAWN BY	[illegible]
SCALE	2:1 MATERIAL - MILD STEEL

WATERLINE EQUIPMENT LTD

Figure 5b



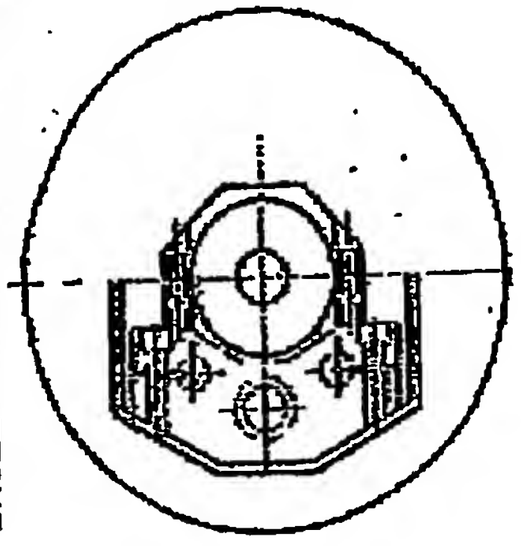
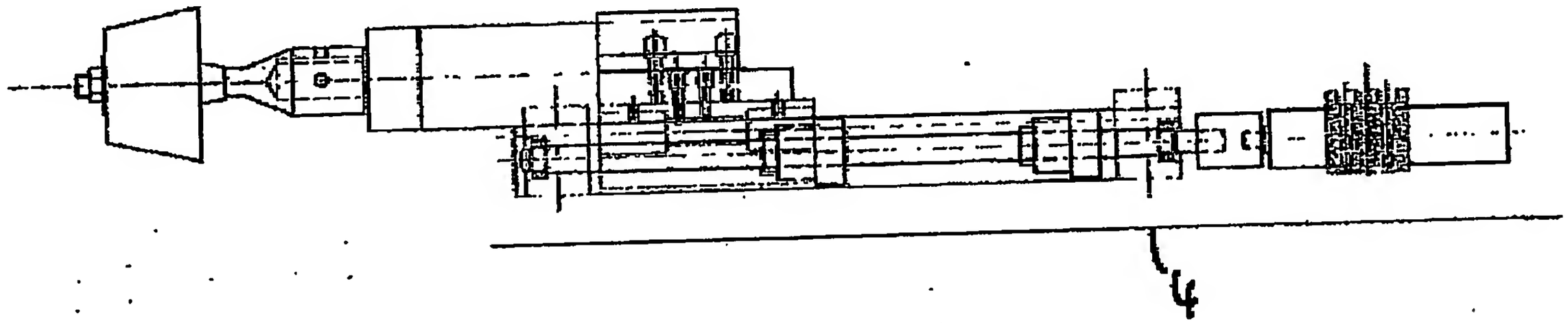


Figure 5d

Figure 5a



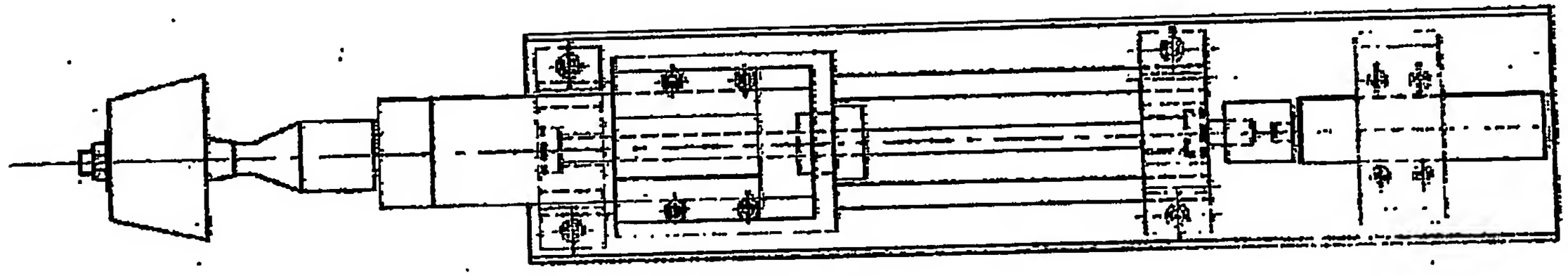


Figure 5c